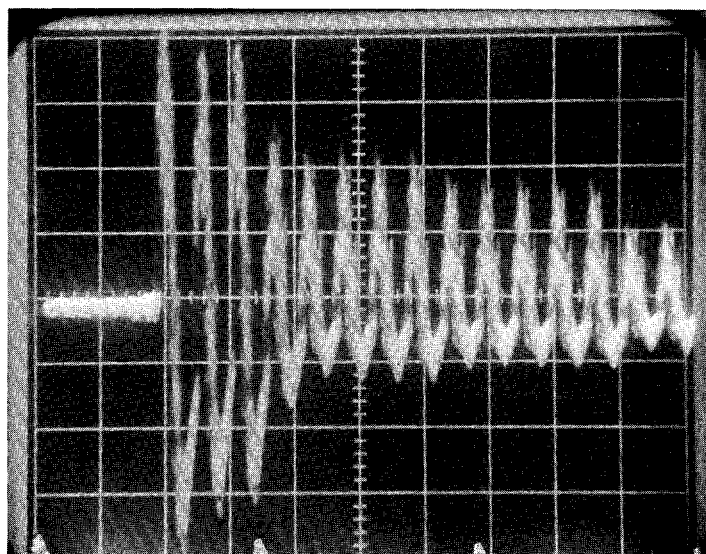
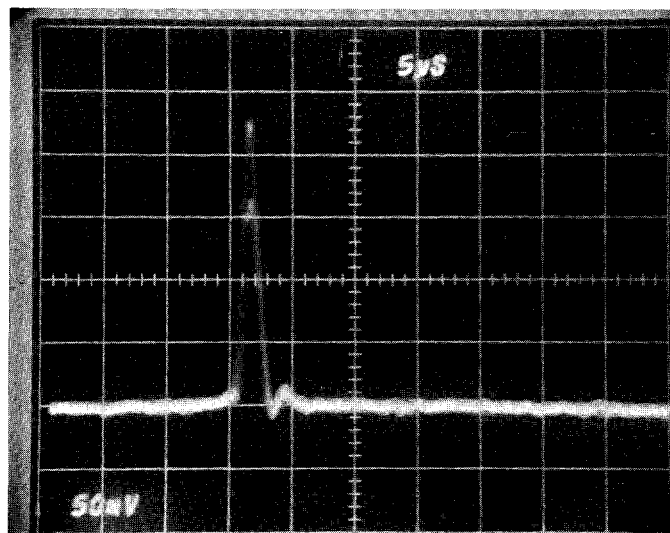




**MONTHLY REPORT OF ACTIVITIES**

**January 31, 1971**



**COASTING BEAM IN THE BOOSTER**



FORTHCOMING MEETINGS AT THE LABORATORY

Program Advisory Committee	Feb. 27-28
Fifteen-foot bubble-chamber workshop	Mar. 11-12

THE COVER: The upper oscilloscope trace shows the first turn around the booster. The large pip is the injected beam; the small pip 3.5 microseconds is the beam after one turn. The lower trace shows circulating beam a week later. Each oscilloscope pip of the signal represents one turn.

## MONTHLY REPORT OF ACTIVITIES

F. T. Cole

January 31, 1971

**Abstract:** This report summarizes the activities of the National Accelerator Laboratory in January, 1971.

### Booster

January has been a time of high excitement for the Booster Section. Just after midnight on January 24, the 200-MeV beam was injected and brought around a complete turn. One of the cover photographs shows the signal of this beam. A few hours of tuning brought the beam to the condition shown in Fig. 1, where there is almost no loss after injection. This can be taken as a good indication that the booster magnet ring is adequately aligned

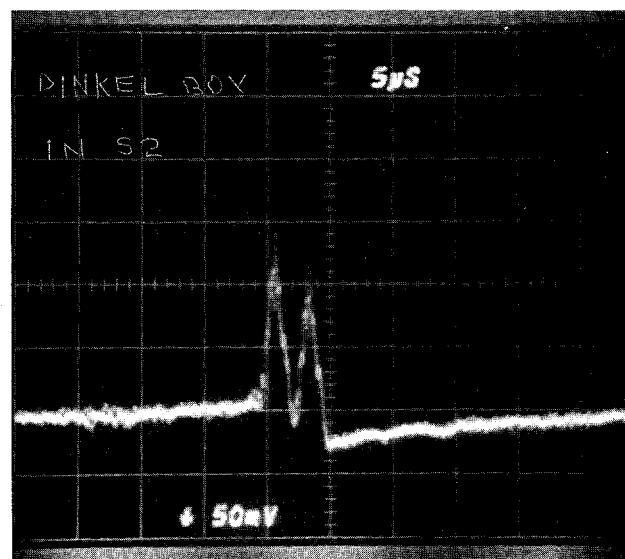


Fig. 1. One-turn beam in the Booster after a few hours of tuning. A "Dinkel Box" is a beam detector developed by John Dinkel of the Booster Section. "S2" is the short straight section immediately downstream of the injection point.

and that the magnets have been built as specified. The orbit deviations are, from preliminary measurements, less than 0.5 inch, even without corrections. After injection, the beam signal was rapidly found on detectors around the ring, without recourse to the correcting magnets.

In order that installation work can continue in the tunnels, the Booster has been operated only on Thursday night and through all of Friday. The operation has also been shut down the last several weekends for work to change over from temporary to permanent power. It was not possible to try for more than one turn on January 24, because a pulsed kicker magnet to put the beam on orbit had not yet been installed and the dc kicker necessarily ejected the beam on the second turn. This pulsed kicker was installed early in the next week and test began again on January 28. The first multiple-turn signals were detected at about 5 p.m. on January 29. Again, a few hours of tuning improved the signals greatly, to the point shown in the second cover photograph. One can see dimly in this photo (and much more clearly in others) a pattern of loss every four turns, which indicates that the betatron oscillation frequencies are close to the design values. The beam signal decays with a mean lifetime of the order of 1 millisecond, which is in qualitative agreement with either gas-scattering beam loss or signal loss from debunching.

The magnet system was then powered with alternating current. An attempt was just beginning to capture the beam with radio frequency when a leaking water-cooling line forced the weekend shutdown to begin a few hours early, at 4 a.m. on January 30. These tests will be taken up again during next week's operating period.

This splendid operation is a tribute to the way in which Roy Billinge, Booster Section Leader, Helen Edwards, Associate Section Leader, and all the people of the Booster Section have carried out their job.

### Linac

A large part of the linac operation during January has been for booster injection. Progress has also been made in improving the reliability of these new systems; there was a large reduction in the amount of linac down-time through the month, as component problems were diagnosed and solved. There was also significant advance in the study of beam properties; the relative momentum spread of the 200-MeV beam, of which a computer-produced plot is shown in Fig. 2, is now approximately 0.25% full width. Lee Teng and

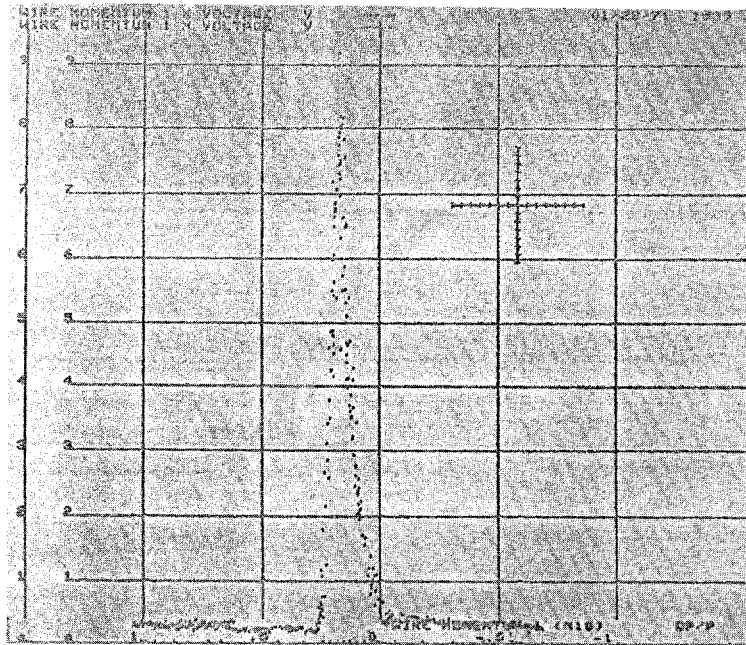


Fig. 2. Momentum spread from the Linac. Perhaps as much as one-third of the indicated  $\Delta p/p$  is really due to beam size (transverse emittance), so that  $\Delta p/p$  is lower than shown. This kind of plot is produced in a few seconds by the Linac control computer.

Shoroku Ohnuma of the Accelerator Theory Section have devoted considerable time to helping this work. Ohnuma's suggestion for changing phase in the last tank has been instrumental in achieving the momentum spread quoted here. It is hoped with more work to reduce the momentum spread even further.

Most of the linac operation can now be carried out remotely from the main control room to which the Linac Section pipes ever new and more glamorous displays of its operation. Figure 2 is an example.

#### Radio Frequency

Installation has been completed on the Booster West Gallery equipment. The rf control system in the West Gallery has been put into operation. One cavity was powered at the end of January, and tests are beginning with the frequency program generated by the low-level rf program. Installation and initial operation of the East Gallery equipment will be completed in February.

#### Main Accelerator

Magnet production has risen to 42 per week and is still increasing as Will Hanson, who was in charge of Booster magnet production, now performs his magic on production of main-ring magnets. A total of 561 magnets has been produced, of which 368 (one-third of the total) are in the tunnel.

Last month's report had a somewhat confused statement on quadrupole measurements. Stated correctly, the change in the quadrupole-lamination die was made to improve the field shape at high fields, not to reduce the displacement of the magnetic center. This displacement is a separate problem, caused by localized iron in the support structure and is now considered curable, but not serious.

All power-supply transformers have been placed at the service buildings and the installation is complete through Superperiod C.

### Experimental Facilities

1. Neutrino Laboratory. The Linac Section is beginning work on design of technical equipment for the Neutrino Laboratory, under what we are calling a "subcontract" with Experimental Facilities.
2. Proton Laboratory. The conceptual design of another experimental area, the "Proton Laboratory," is being intensively studied. Although it is too early in the design work to describe its structure, its location has been fixed. It will be approximately 300 feet southeast of the Neutrino Laboratory target area. The classes of experiments envisaged for this Laboratory include beam surveys at large angles, proton-proton elastic scattering at large angles, searches for intermediate bosons or the Feynman cutoff particle, and nuclear chemistry.

### Construction Progress

1. Electrical Substation. The substation was energized on January 21. Figure 3 is a photograph taken at the time. Work is still in progress to complete alternations to the original design needed for 500-BeV operation. This work is expected to be complete at the beginning of March. The substation contract as a whole is 97% complete. The distribution system to the Linac, Booster, Cross Gallery, and Beam Transfer area will be in operation early in February. The pulsed-power distribution to the Main Accelerator will be complete shortly after.

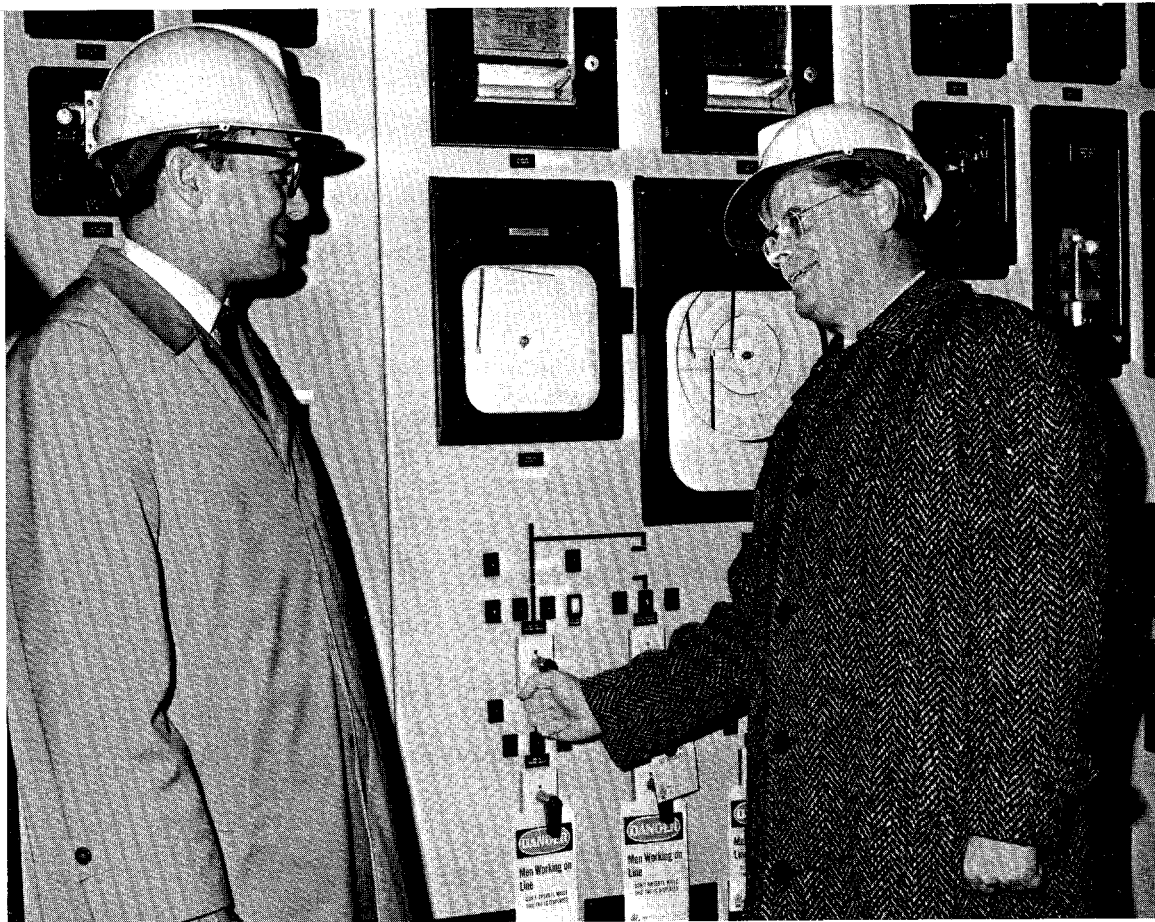


Fig. 3. Mr. D. A. Schindlbeck of the Commonwealth Edison Co. and R. R. Wilson about to throw the switch.

2. Main Accelerator. Backfilling to the level of the top of the tunnel (needed to stabilize the temperature inside) is almost complete for the entire tunnel. Finishing work is going on in the remaining service buildings. The contract is 94% complete.

3. Proton Beam Enclosure. Outside work continued except on the very coldest days, one of which is shown in Fig. 4. The crossing at the junction of Roads A and B is almost complete. When that road junction is again





Fig. 4. The Proton Beam Enclosure, looking back toward the Injection Area.

available for our access to the Linac and Booster, Road D (the "Village Expressway") will be cut for construction of the beam tunnel under it. The contract is 62% complete.

4. Central Laboratory. The first phase, the contract for the basement and ground floor, is 45% complete. Several columns have been placed and forming for the north wall is going up, as one can see in Fig. 5.

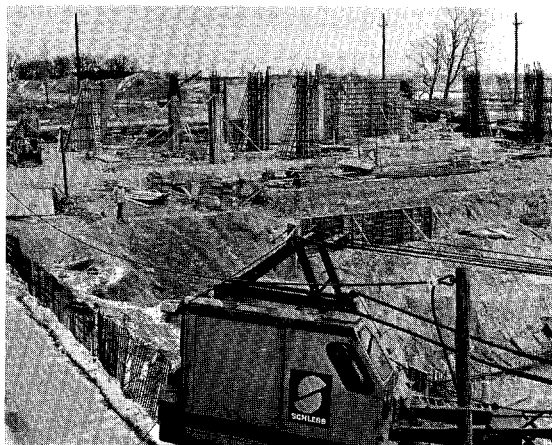


Fig. 5. Work on the Central Laboratory, viewed from the Linac Building. The basement is at the right of the photograph; the north-wall and column forms are beyond the crane.

5. Meson Laboratory. Figure 6 shows the caisson drilling for the target area. This caisson work is at the halfway mark. The first phase of the Meson Laboratory, the target area, is 19% complete. The second phase of

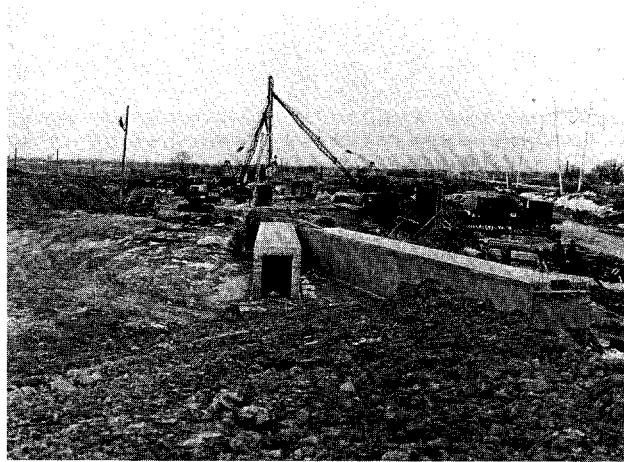


Fig. 6. Work on the Meson Laboratory target area. The view is along the beam line upstream of the target. The caisson work can be seen behind. To the right is the main power line.

the Meson Laboratory, from the target area to the detector building, is 7% complete and is still largely excavating work.

6. Neutrino Laboratory. The contract for the target area is 7% complete. This progress is mostly in site preparation and excavation. In other work on the Neutrino Laboratory, concrete has been placed for the reaction mass for the 15-foot bubble chamber. This work is shown in Fig. 7. New contracts have been let, one for \$1.086 million to the Wil-Freds Company of Naperville (who built the Industrial Buildings) for the Bubble-Chamber and Bubble-Chamber Assembly Buildings in the Neutrino Laboratory, and one for \$40 thousand to the Herlihy Mid-Continent Co. (who built the Booster Enclosure) for erection of a prefabricated building in the Muon Laboratory part of the Neutrino Laboratory.

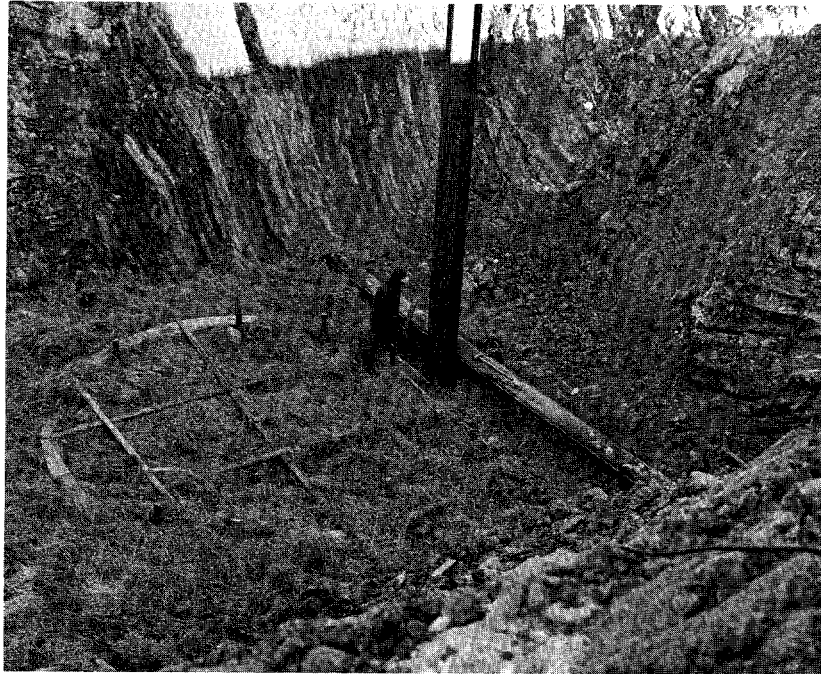


Fig. 7. Under all the straw is the reaction mass for the 15-foot bubble chamber.

